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The theory of inhomogeneously broadened and hyperfine split EPR spectra in superconductors

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Abstract

The theory of EPR in type-II superconductors, developed previously (see ibid., vol.17, p.695, 1987), is extended to include the inhomogeneous broadening and hyperfine structure effects. The appropriate kinetic equations are obtained and solved describing the coupled motion of transverse magnetisation of conduction electrons and transverse magnetisation of magnetic impurities, subject to the action of static spatially random local fields. The solution is analysed analytically and numerically for specific local-field distribution functions. It is shown that even under very soft 'bottleneck' conditions the EPR line exhibits a sharp narrowing just below the superconducting transition temperature Tc. This narrowing occurs primarily because of the decreasing of the inhomogeneous linewidth due to 'superconducting' enhancement of the Korringa relaxation rate, which governs the degree of the narrowing under the bottleneck conditions. It is demonstrated how the exponential decrease of the relaxation rates at temperatures T<